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ARMY ENGINEER DISTRICT NORFOLK VA F/G 13/13  
NATIONAL DAM SAFETY PROGRAM. THORNHILL DAM (VA 15505), NEW RIVE--ETC(U)  
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# NEW RIVER BASIN

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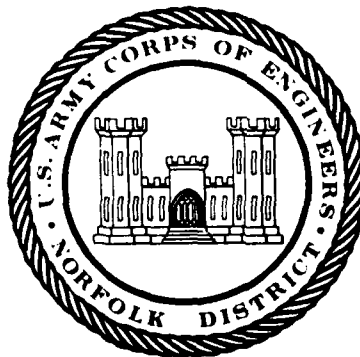


Name Of Dam: THORNHILL

Location: PULASKI COUNTY

Inventory Number: VA 15505

## PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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PREPARED BY

NORFOLK DISTRICT CORPS OF ENGINEERS

803 FRONT STREET

NORFOLK, VIRGINIA 23510

DECEMBER 1980

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| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  |                       |  |

## 20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspection. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

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NEW RIVER BASIN

NAME OF DAM: THORNHILL DAM  
LOCATION: PULASKI COUNTY  
INVENTORY NUMBER: VA 15505

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY  
NORFOLK DISTRICT CORPS OF ENGINEERS  
803 FRONT STREET  
NORFOLK, VIRGINIA 23510

## TABLE OF CONTENTS

Preface . . . . . i

Brief Assessment of Dam . . . . . ii

### Overview of Dam

Section 1: PROJECT INFORMATION . . . . . 1-1

Section 2: ENGINEERING DATA . . . . . 2-1

Section 3: VISUAL INSPECTION . . . . . 3-1

Section 4: OPERATIONAL PROCEDURES . . . . . 4-1

Section 5: HYDRAULIC/HYDROLOGIC DATA . . . . . 5-1

Section 6: DAM STABILITY . . . . . 6-1

Section 7: ASSESSMENT/REMEDIAL MEASURES . . . . . 7-1

Appendix I: Maps and Drawings

Appendix II: Photographs

Appendix III: Field Observations

Appendix IV: References

## PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam: Thornhill  
State: Virginia  
Location: Pulaski County  
USGS Quad Sheet: Pulaski, Virginia  
Stream: Tributary of Bentley Branch  
Date of Inspection: 17 December 1980

Thornhill Dam is an earthfill structure 505 feet long and 25.1 feet high. The dam is owned and maintained by Glen O. Thornhill of Salem, Virginia. The dam is classified as a small dam with a significant hazard classification. The principal spillway is a 24-inch cast iron pipe drop-inlet that connects to an 18-inch corrugated metal pipe that passes through the dam at low level. Both the left and right emergency spillways are earthen open channels cut into natural ground at each abutment. The reservoir is used for recreation.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the 1/2 PMF. The spillways will pass 22% of the PMF or 44% of the SDF without overtopping the dam. The SDF will overtop the dam by a maximum 0.75 feet, reach an average critical velocity of 3.8 feet per second and flow over the dam for 1.75 hours. Flows overtopping the dam during the SDF are not considered detrimental to the embankment. The spillways are adjudged inadequate but not seriously inadequate.

The visual inspection revealed no findings that proved the dam to be unsound. A stability check is not required. However, the inspection did reveal a shallow stable slough combined with a seep and wet spot in the vicinity of the spillway outlet pipe along the embankment and right abutment toe. There is no regular maintenance operation program or warning system. It is recommended a regular documented maintenance program be implemented and a formal emergency procedure prepared. Also, the slough area should be periodically monitored. If the slough area enlarges or the seep becomes cloudy, the reservoir should be immediately drawdown and a geotechnical engineering firm be retained to further evaluate the condition. In addition, the items listed in Section 7.2 should be accomplished as part of the regular maintenance program within the next 12 months.



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DAM



RESERVOIR AREA

# OVERALL VIEWS OF THORNHILL DAM

17 DECEMBER 1980

## SECTION 1

### PROJECT INFORMATION

#### 1.1 GENERAL:

1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Reference 1, Appendix IV). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

#### 1.2 Project Description:

1.2.1 Dam and Appurtenances: Thornhill Dam is an earthfill embankment structure about 505 feet long and 25.1 feet high. The crest of the dam is 11.5 feet wide with a crest elevation of 2108.3 feet msl. The upstream slope is 3.3 horizontal to 1 vertical (3.3H:1V) and the downstream slope is 3H:1V. Riprap is placed on the embankment about 20 feet either side of the principal spillway drop-inlet.

It is unknown if the dam is keyed into the foundation or whether or not there is a drainage system. There are no foundation drain outlets.

The principal spillway is a 24-inch cast iron pipe drop-inlet that connects to an 18-inch corrugated metal pipe that passes through the dam at low level. The crest of the drop-inlet is at elevation 2100. The pipe outlets into an unprotected stilling basin. The invert elevation of the outlet pipe is 2085.9.

The right emergency spillway is an open channel trapezoidal shape cut in natural ground. The crest is at elevation 2104.7, which is approximately 25 feet wide. An earth berm provides protection of the toe of the dam by directing flows 200 feet downstream before it enters the downstream channel.

The left emergency spillway is an open channel trapezoidal shape cut in natural ground. The crest is at elevation 2105.4, which is approximately 25 feet wide. A small earth berm provides some protection for the toe of the dam.

An emergency drawdown gate is located at about elevation 2087.6 with the stem located at the end of a wooden walkway accessible from the upstream embankment.

1.2.2 Location: Thornhill Dam is located on a tributary of Bentley Branch about 1.5 miles northwest of Weldon, Virginia. A location map is provided in Appendix I.

1.2.3 Size Classification: The dam is classified as a small dam as defined by Reference 1 of Appendix IV.

1.2.4 Hazard Classification: The dam is located upstream of a farming community of which some structures may receive damage should a dam failure occur. Therefore, a significant hazard classification is given for this structure according to guidelines contained in Section 2.1.2 of Reference 1, Appendix IV. The hazard classification used to categorize dams is a function of location only and has nothing to do with their stability or probability of failure.

1.2.5 Ownership: Mr. Glen O. Thornhill of Salem, Virginia.

1.2.6 Purpose: Recreation and agricultural water supply.

1.2.7 Design and Construction History: Inventory update efforts indicate that the design of the dam was assisted by the U. S. Agriculture Department, Soil Conservation Service in the early 1950's. Wiley N. Jackson, a prominent contractor from Roanoke, Virginia was the contractor that finished the dam in 1952.

1.2.8 Normal Operational Procedures: Water passes automatically through the principal and emergency spillways as the reservoir rises above the spillways crests.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 0.46 square miles.

1.3.2 Discharge at Dam Site: Maximum flood - unknown.

Pool level at crest of dam

Principal Spillway . . . . . 38 cfs  
Right Emergency Spillway . . . . . 444 cfs  
Left Emergency Spillway . . . . . 321 cfs

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

| Item                                     | Elevation<br>feet<br>msl | Reservoir      |               |                      |                |
|--|--------------------------|----------------|---------------|----------------------|----------------|
|  |                          | Area,<br>acres | Capacity      |                      | Length<br>feet |
|  |                          |                | Acre,<br>feet | Watershed,<br>inches |                |
| Crest of Dam                             | 2108.3                   | 7              | 80            | 3.3                  | 1200           |
| Left Emergency<br>Spillway Crest         | 2105.4                   | 6              | 62            | 2.5                  | 1100           |
| Right Emergency<br>Spillway Crest        | 2104.7                   | 5.8            | 55            | 2.2                  | 1050           |
| Principal Spillway<br>Crest              | 2100.0                   | 4.6            | 29.9          | 1.2                  | 900            |
| Streambed at Down -<br>stream toe of dam | 2083.2                   | -              | -             | -                    | -              |

## SECTION 2

### ENGINEERING DATA

- 2.1 Design: There is no known design information.
- 2.2 Construction: There are no known construction records.
- 2.3 Evaluation: There is insufficient information to evaluate foundation conditions and embankment stability.

## SECTION 3

### VISUAL INSPECTION

#### 3.1 Findings:

3.1.1 General: The results of the 17 December 1980 inspection are recorded in Appendix III. At the time of the inspection the weather was sunny and clear. The temperature was approximately 35° F. and the ground conditions were dry to moist. The pool elevation was 2099.1 or about 0.9 feet below normal pool elevation. No flow was passing through the emergency spillway. There are no known preceding inspection reports.

3.1.2 Embankment: The embankment was found to be in good condition with no signs of surface cracking or misalignment. A sketch showing a plan view and cross section is provided on Plate 1. Overall views of the dam are provided at the beginning of the report. The only riprap protection on the face of the dam is that which extends 20+ feet on either side of the principal spillway drop inlet. Reservoir fluctuations have created a bench along the embankment toe extending 1.5+ feet above the reservoir level. There is a pedestrian path running along the upstream face of the dam. There is minor surface erosion and minor sloughing on the left upstream abutment slope aggravated by cattle traffic and surface runoff. The embankment toe from the outlet to the right abutment and the right abutment toe immediately downstream of the embankment have sloughed. The sloughing is also aggravated by cattle traffic around the plunge pool. There is a seep existing from the abutment slope. There is a large wet spot in the immediate downstream area left of the outlet pipe. The outlet pipe headwall is badly cracked and buckled in a downstream direction. The outlet pipe is kinked about 15 feet upstream of the headwall. There are no signs of creep, cracking, or other movement of the embankment and abutments above the eroded area. It is unknown if the source of the abutment seep is natural or from the reservoir. It is suspected the wet spot at the toe is caused by seepage through the embankment and runoff.

3.1.3 Principal Spillway: The principal spillway is a 24-inch cast iron pipe drop inlet that connects to an 18-inch corrugated metal pipe which passes at low level through the dam. Bars used as a trash rack are welded to the crest of the drop inlet. An emergency gate services the 18-inch CMP pipe before it enters the principal spillway outlet. A locked wheel on the gate stem appears secure. A concrete headwall is located at the pipes exit point. The headwall, as noted above, is cracked in several places and is buckled in a downstream direction. The outlet channel is shallow and narrow with no riprap protection. The channel meanders downstream furnishing water to livestock.

3.1.4 Emergency Spillway: There is an emergency spillway on both the right and left abutment. The control section on both is an open cut into natural ground. The spillways are approximately 25.0 feet wide. The control sections are grass covered with the exception of a few bare spots. The approach channels are grass covered with no obstructions. The grassed discharge channels are diverted downstream by earthen berms located at either end of the dam embankment.

3.1.5 Instrumentation: There is no instrumentation on the dam.

3.1.6 Reservoir: The reservoir slopes are mild with little erosion. About 90% of the immediate area is pasture land with the remainder heavily wooded.

3.1.7 Downstream Channel: The downstream channel is shallow and narrow. The flood plain is wide with little debris. The area is agricultural with thick grass over most of the area. The slopes are mild with good grass cover. Several farm structures are within one mile below the dam.

3.2 Evaluation: The slough to the right of the outlet pipe is a shallow slope failure. However, there is no evidence of continuing failure such as piping or tension cracks. The cause of the sloughing is not clear. It is suspected that sometime in the past, discharge flow eroded the toe. This combined with the general wet conditions, which reduced the strength of the embankment and abutment, caused the slough. In light of the fact that there are no present signs of continuing erosion, no emergency remedial measures are recommended. The discharge channel should be riprapped 25 feet downstream to prevent further erosion. The area should be periodically monitored particularly after large discharges. If the sloughed area enlarges or the seep becomes cloudy, the reservoir should immediately be drawn down and a geotechnical engineering firm be retained to further evaluate the condition.

Overall the dam appears to be in good condition. The inspection revealed certain preventive maintenance items which should be scheduled as part of an annual maintenance program. These are:

a. The eroded area observed along the left upstream abutment and embankment face should be graded and seeded in order to prevent further erosion.

b. The sloughed area around the plunge pool should be backfilled and seeded, and the perimeter of the plunge pool should be riprapped to prevent further erosion.

c. A fence should be installed around the sloughed area to limit animal access to this area.

d. A staff gage should be installed to monitor water levels.



## SECTION 4

### OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool is 2100.0, which is the crest of the principal spillway. The reservoir provides recreation and water for farm animals. Water passes automatically through the principal spillway as the water level rises above the principal spillway crest. Water will also pass automatically through the emergency spillways when the water level in the reservoir rises above the emergency spillways crests. An emergency drawdown gate of unknown size is available to drain the reservoir, if needed.

4.2 Maintenance: There is no regular maintenance program for Thornhill Dam. Cattle are allowed to graze on the embankment which controls the growth of grass.

4.3 Warning System: At present time, there is no warning system or evacuation plan for Thornhill Dam.

4.4 Evaluation: The dam does not require an elaborate operational and maintenance procedure. However, a regular documented maintenance program should be initiated to help detect and correct problems as they occur. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

- a. How to operate the dam during an emergency.
- b. Who to notify, including public officials, in case evacuation from the downstream area is necessary.

## SECTION 5

### HYDRAULIC/HYDROLOGIC DATA

5.1 Design: None were available.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: The maximum flow at the dam site is not known.

5.4 Flood Potential: The 100 Year Flood, 1/2 PMF, and PMF were developed and routed through the reservoir by use of the HEC-1DB computer program (Reference 2, Appendix IV) and appropriate unit hydrograph, precipitation and storage-outflow data. Clark's Tc and R coefficients for the local drainage area were estimated from basin characteristics. The rainfall applied to the developed unit hydrograph was obtained from U. S. Weather Bureau Publications (References 3 and 4 of Appendix IV).

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1.

Water passes automatically through the principal and emergency spillways as the reservoir rises above the spillways crests.

The storage curve was developed based on areas obtained from a U. S. Geological Survey Quadrangle Map. Survey data taken during the inspection was correlated to the Pulaski, Virginia Quadrangle Map to help develop the area-storage data. Rating curves for the non-overflow section, both emergency spillways, principal spillway and drawdown were developed. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at the principal spillway crest (elevation 2100.0).

5.6 Overtopping Potential: The probable rise in the reservoir and other information on reservoir performance is shown in the following table:

Table 5.1 RESERVOIR PERFORMANCE

| Item                                       | Normal<br>Flow | 100 1/<br>Year | 1/2 PMF | PMF 2/  |
|--|----------------|----------------|---------|---------|
| Peak flow c.f.s.                           |                |                |         |         |
| Inflow                                     | 1              | 629            | 1977    | 3953    |
| Outflow                                    | 1              | 444            | 1955    | 3877    |
| Maximum elevation<br>ft. msl               | 2100.0         | 2107.27        | 2109.05 | 2109.94 |
| Non-overflow section<br>(el 2108.3 ft msl) |                |                |         |         |
| Depth of flow, ft                          | -              | -              | .75     | 1.64    |
| Duration, hrs                              | -              | -              | 1.75    | 3.5     |
| Velocity, fps 3/                           | -              | -              | 3.8     | 5.6     |
| Tailwater elevation<br>ft. msl.            | 2084.1         | -              | -       | -       |

1/ The 100 Year Flood has one chance in 100 of occurring in any given year.

2/ The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

3/ Critical Velocity

5.7 Reservoir Emptying Potential: An assumed 18-inch corrugated metal pipe intake is available for lowering the reservoir. The low level outlet will permit a withdrawal of about 29 cfs with the reservoir level at the crest of the principal spillway and essentially dewater the reservoir in less than one day. This is equivalent to an approximate drawdown rate of 12.4 feet per day. This is based on the hydraulic height measured from the maximum storage pool at elevation 2100.0 to elevation 2087.6 divided by the time to dewater the reservoir.

5.8 Evaluation: Based on the size (small) and hazard classification (significant) the recommended Spillway Design Flood is the 100 Year Flood to the 1/2 PMF. Because of the risk involved, the 1/2 PMF has been selected as the SDF. The emergency spillways will pass 22% of the PMF or 44% of the SDF without overtopping the dam. The SDF will overtop the dam by a maximum 0.75 feet, reach an average initial velocity of 3.8 feet per second and flow over the dam for 1.75 hours.

Conclusions pertain to present day conditions. The effect of future development on the hydrology has not been considered.

## SECTION 6

### DAM STABILITY

**6.1 Foundation and Abutment:** There is no information available on the foundation conditions. The dam is located in the Appalachian Valley Province and is underlain by the Rome formation of Cambrian age. The Rome is a heterogeneous formation consisting of red and green shale, sandstone and dolomite. It is unknown if the dam is keyed into the foundation or whether or not there is a drainage system. There are no foundation drain outlets.

**6.2.1 Material:** There is no information available on the nature of the embankment materials. The only known information is that the borrow area was located in the reservoir area. The area soils are medium plastic clayey silts.

**6.2.2 Stability:** There are no available stability calculations. The dam is 25 feet high and 11.5 feet wide. The upstream slope is 3.3H:1V and has no riprap protection. The downstream slope is 3H:1V. The dam is subjected to a sudden drawdown because the approximate reservoir drawdown rate of 12.0+ feet per day exceeds the critical rate of 0.5 feet per day for earth dams. The existing pool is approximately 5.8 feet below maximum control storage pool which is at the elevation of the lower emergency spillway.

According to the guidelines presented in Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation (Reference 5) for small homogeneous dams, with a stable foundation, subjected to a drawdown, and composed of medium plastic fines (CL, ML), the recommended slopes are 3.5H:1V upstream and 2.5H:1V downstream. The recommended width is 15 feet. Based on these guidelines, the dam has adequate slopes and an inadequate crest width.

**6.2.3 Seismic Stability:** The dam is located in Seismic Zone 2. Therefore, according to the Recommended Guidelines for Safety Inspection of Dams, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

**6.3 Evaluation:** There is insufficient information to adequately evaluate the stability of the dam. Also the visual inspection revealed a shallow slope failure at the toe of the embankment in the vicinity of the outlet pipe and at the toe of the immediate right abutment. However, there are no signs of continuing failure and the downstream slope is much flatter than recommended by the Bureau guidelines. Therefore the area is considered stable. Based on the Bureau of Reclamation guidelines, the width is inadequate, but the slopes are adequate. In addition, overtopping is not a problem because flows are shallow, last 1.75 hours, and the velocity is less than 6 fps, the effective eroding velocity for a vegetated earth embankment. Stability calculations are not required, because the visual inspection revealed no immediate problems and the sideslopes are adequate.

## SECTION 7

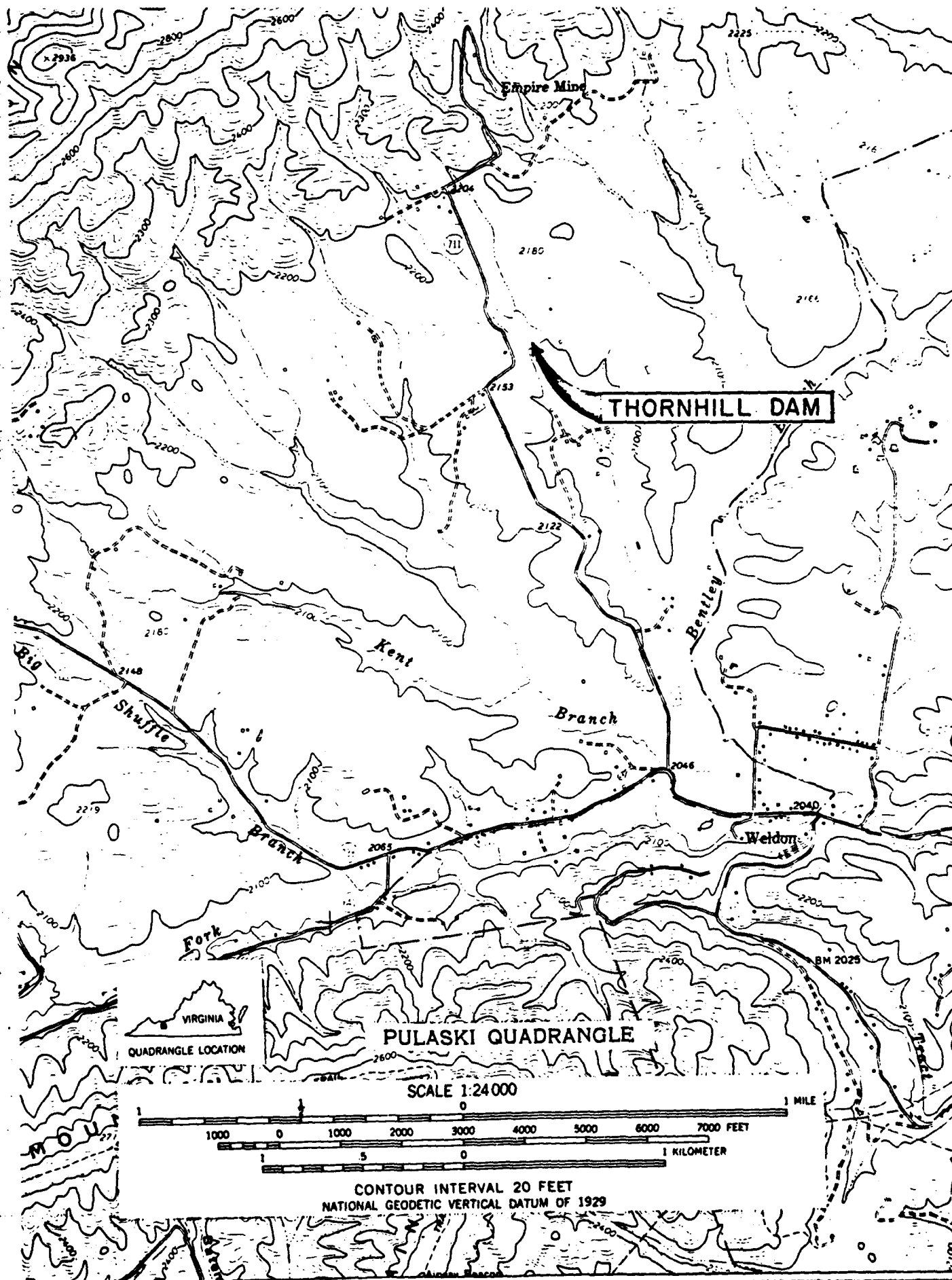
### ASSESSMENT/REMEDIAL MEASURES

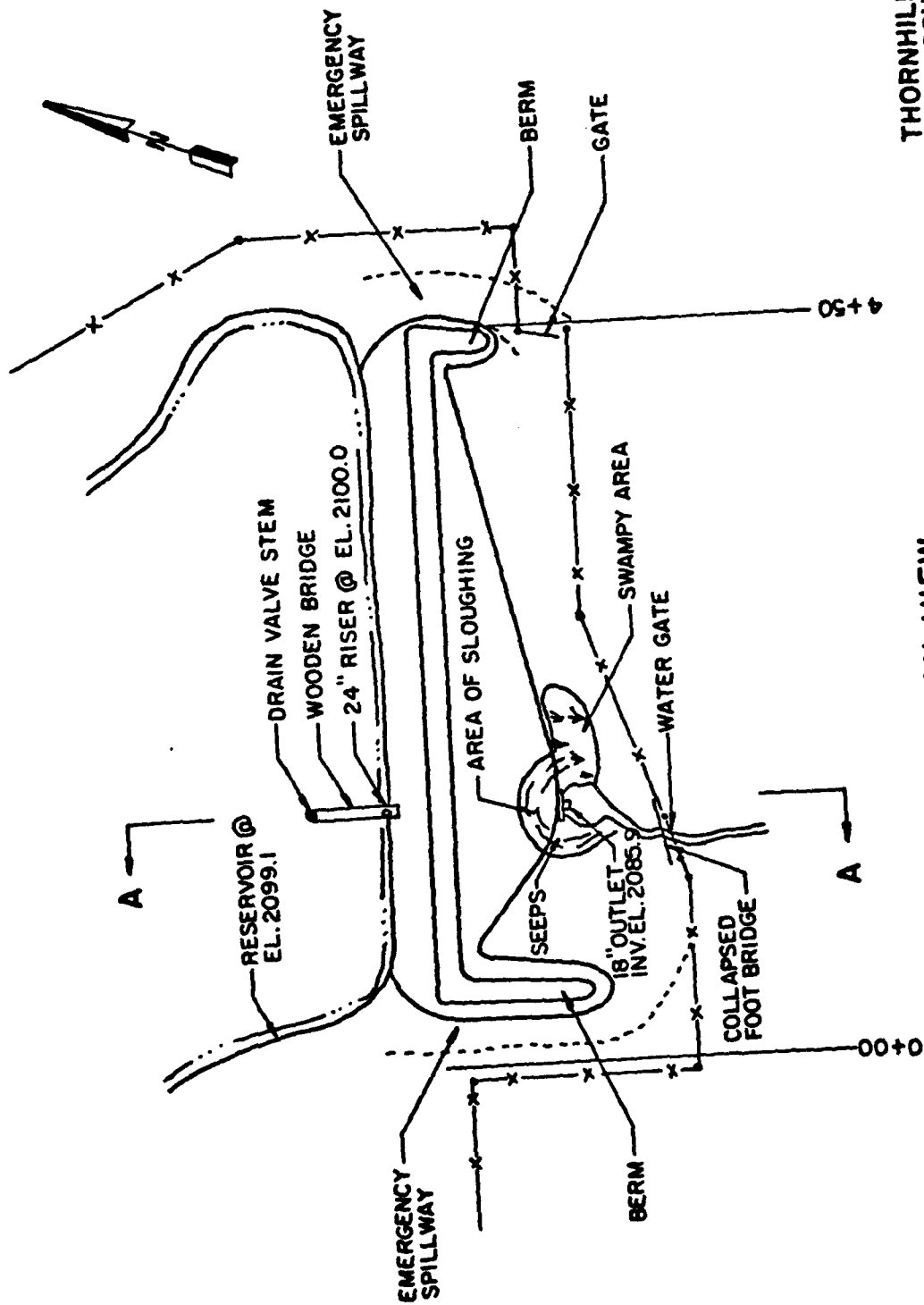
7.1 Dam Assessment: The available engineering data is inadequate. The visual inspection revealed no findings that proved the dam to be unsound. However, the inspection did reveal a shallow stable slough combined with a seep and wet spot in the vicinity of the outlet pipe along the embankment and right abutment toe. There is neither a regular maintenance program nor an emergency operation and warning plan. Overall, the dam is in good condition and there is no immediate need for remedial measures. Corps guidelines indicate the appropriate Spillway Design Flood (SDF) for an small size and significant hazard dam is the 1/2 PMF. The spillway will pass 22 percent of the PMF without overtopping the dam. The combined capacity of the spillways is adjudged inadequate but not seriously inadequate. Flows overtopping the dam during the SDF are not considered detrimental to the embankment. A stability check of the dam is not required.

7.2 Recommended Remedial Measures: It is recommended that a regular documented maintenance program be implemented. A formal emergency procedure should be prepared and furnished to all operating personnel. This should include how to operate the dam during an emergency, and who to notify including public officials, in case evacuation from the downstream area is necessary. Also the slough area should be periodically monitored, particularly after large discharges. If the slough area enlarges or the seep becomes cloudy, the reservoir should immediately be drawn down and a geotechnical engineering firm be retained to further evaluate the condition. In addition, the inspection revealed the following maintenance items that should be scheduled by the owner during a regular maintenance period within the next 12 months:

- a. The eroded area observed along the left upstream abutment and embankment face should be graded and seeded in order to prevent further erosion.
- b. The sloughed area around the plunge pool should be backfilled and seeded, and the perimeter of the plunge pool should be riprapped to prevent future erosion.
- c. A fence should be installed around the sloughed area to limit animal access to this area.
- d. A staff gage should be installed to monitor water levels.

APPENDIX I  
MAPS AND DRAWINGS

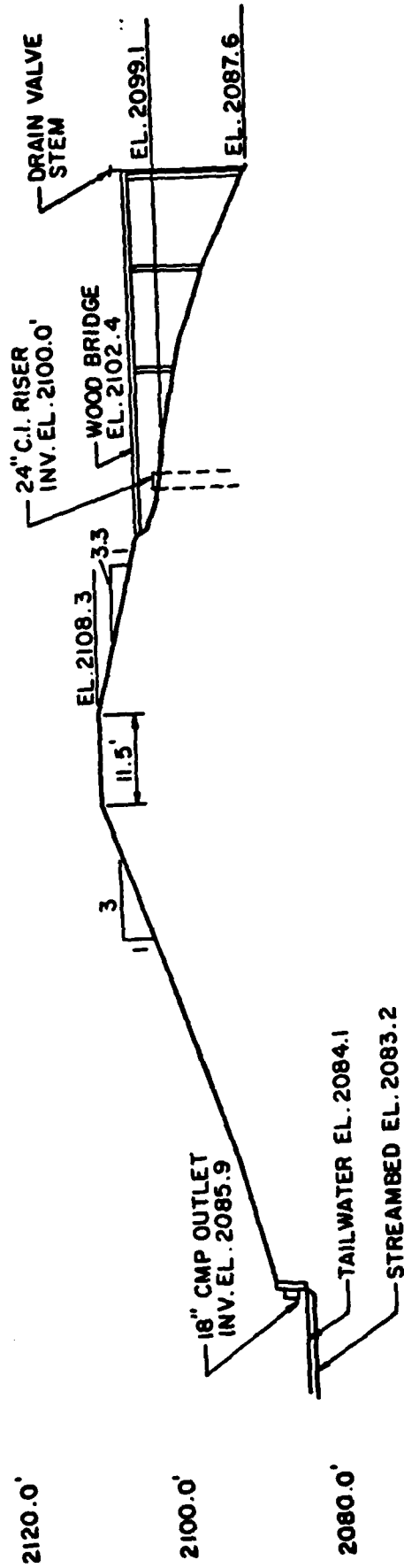
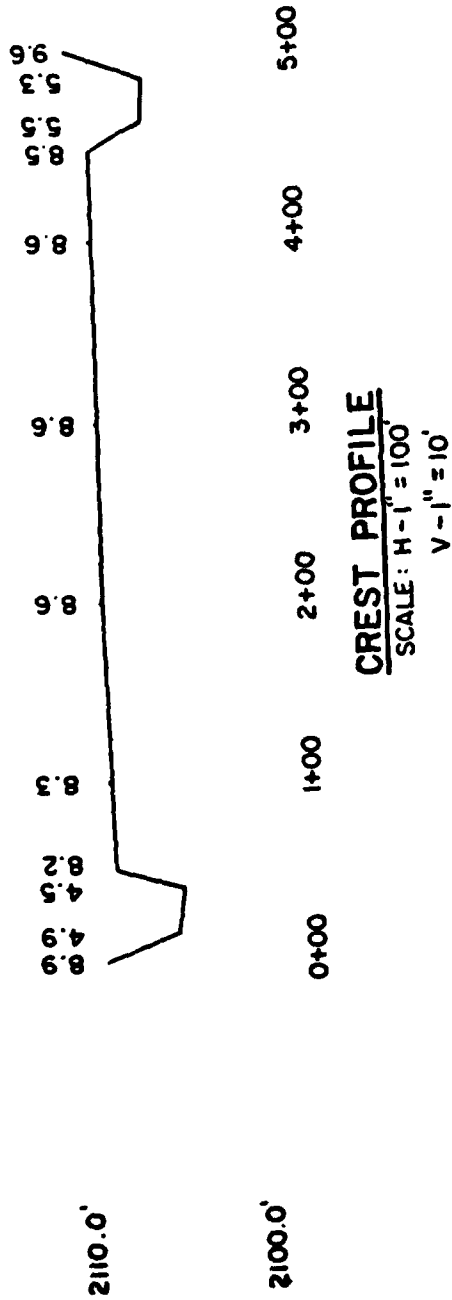




THORNHILL DAM  
 PULASKI COUNTY, VA.  
 17 DEC 80  
 STATE WATER CONTROL  
 BOARD  
 PLATE 1

PLAN VIEW  
N.T.S.





NOTE:  
 ALL ELEVATIONS BASED ON TBM  
 WHERE TOP OF 24" RISER PIPE  
 IS EQUAL TO 2100.0'.

THORNHILL DAM  
 PULASKI COUNTY, VA.  
 17 DEC 80  
 STATE WATER CONTROL  
 BOARD  
 PLATE 2

APPENDIX II

PHOTOGRAPHS



PHOTO #1 CREST OF DAM



PHOTO #2 UPSTREAM FACE OF DAM



PHOTO #3 DOWNSTREAM FACE OF DAM

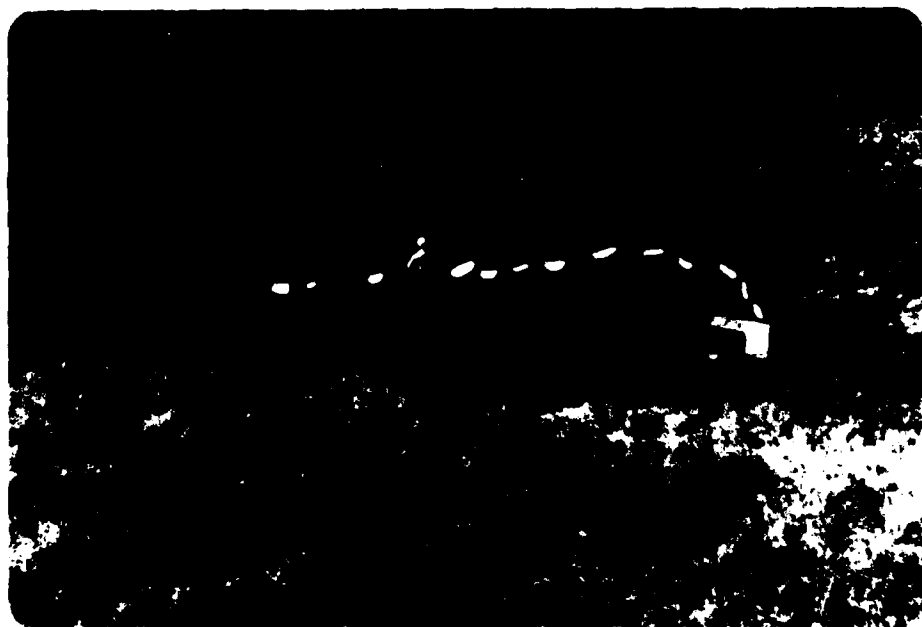


PHOTO #4 SLOUGH ZONE IN  
DOWNSTREAM AREA



PHOTO #5 RESERVOIR DRAIN OPERATOR  
(AT END OF WOODEN WALK)

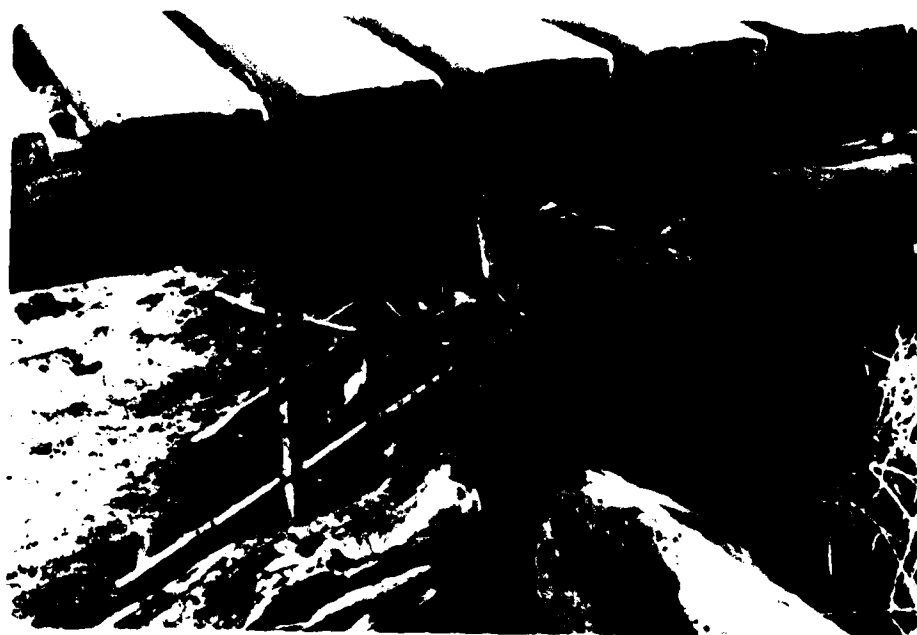


PHOTO #6 PRINCIPAL SPILLWAY INTAKE  
STRUCTURE (UNDER WOODEN  
WALKWAY)



PHOTO #7 PRINCIPAL SPILLWAY OUTLET



PHOTO #8 DOWNSTREAM CHANNEL  
AND AREA

APPENDIX III  
FIELD OBSERVATIONS

Check List  
Visual Inspection  
Phase I

Name Dam: Thornhill Dam      County: Pulaski      State: Virginia      Coordinates: Lat. Long.

Date of Inspection: 17 Dec 80      Weather: Sunny      Temperature: 30° - 40° F.

Pool Elevation at Time of Inspection: 2099.1      Tailwater at Time of Inspection: 2084.1

Inspection Personnel:

B. Taran, COE  
J. Robinson, COE  
M. Byrne, COE  
L. Jones, COE

H. Gildea, SWCB  
D. Bushman, SWCB  
B. E. Stowers, Owner Rep.

Byrne & Robinson

Recorders



# EMBANKMENT

| VISUAL EXAMINATION OF                                  | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS  |
|--|---|---|
| SURFACE CRACKS   | The slopes, crest and abutment contacts were inspected and no cracks were found. The crest and both slopes are covered with grass and straw. No trees are on the dam embankment. The soil type in the area consist of yellow-brown clayey silts (CL-ML).  | None  |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE      | There is no unusual cracking or movement at or beyond the toe. Water fluctuations have created a bench, with a vertical face extending 1.5+ feet above the reservoir level, along the upstream toe.   | None  |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | There is surface erosion and minor sloughing of the left upstream abutment aggravated by cattle traffic and surface runoff. There is a pedestrian path running along the upstream face of the dam. An 18-inch CMP circular spillway pipe exits the downstream toe of the dam near the downstream right abutment. A concrete headwall is located at the outlet point. Effluent from the pipe exits into a plunge pool (40' long x 15' wide). | The eroded and sloughed areas should be dressed with a compacted fill and seeded. The headwall appears relatively stable. The slough should be monitored for future movement. A fence should be installed around the sloughed area to limit animal access to this area. |

# EMBANKMENT (Cont.)

| VISUAL EXAMINATION OF  | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS   |
|--|---|--|
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES (CONTINUED) | <p>The area around the plunge pool has moderate to severe sloughing and erosion. The more severe sloughing extends 20+ feet upstream of the plunge pool and 20+ feet up the right abutment slope. The sloughing is intensified by cattle traffic around the plunge pool. The headwall is severely cracked and is buckled in a downstream direction. The 18-inch outlet pipe is kinked about 15+ feet upstream of the head wall.</p> | <p>This area should be monitored for movement. If the slough increases, the reservoir should be drawn down and a geotechnical engineering firm be consulted to further evaluate the condition.</p> |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST                     | <p>Vertical and horizontal alignment both appear good.</p>  | <p>None</p>  |
| RIPRAP FAILURES  | <p>There is no riprap protection on the dam or around the plunge pool.</p>  | <p>The area around the plunge pool should be ripped.</p>   |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM              | <p>No erosion was noted other than that previously mentioned.</p>   | <p>None</p>  |
| ANY NOTICEABLE SEEPAGE   | <p>A swampy area approximately 70 feet by 40 feet is noted at the toe of the downstream slope adjacent to the plunge pool. The cause of this wet area is not</p>  | <p>The seep should be monitored for piping.</p>  |

# EMBANKMENT (Cont.)

| VISUAL EXAMINATION OF             | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|-----------------------------------|---|----------------------------|
| ANY NOTICEABLE<br>SEEPAGE (CONT.) | known but it may be caused by a<br>combination of natural seepage through<br>the dam and surface runoff. In<br>addition, seeps flowing clear water,<br>are noted in the sloughed area adjacent<br>to the plunge pool on the downstream<br>right abutment. The amount of flow was<br>not estimated. The source is unknown. |                            |
| DRAINS                            | No drains are noted.  | None.                      |

# PRINCIPAL SPILLWAY

| VISUAL EXAMINATION OF | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS   |
|-----------------------|--|--|
| INTAKE STRUCTURE      | The principal spillway is a 24-inch cast iron pipe drop inlet that connects to an 18-inch corrugated metal pipe that passes through the dam at low level. Bars used as a trash rack are welded to the crest of the drop inlet. Minimal debris is noted around the reservoir. | None   |
| OUTLET STRUCTURE      | The concrete retaining wall of which the 18-inch CMP exits is cracked horizontally and vertically. The outlet pipe appears to have buckled slightly about 15 feet upstream of the outlet.  | Monitor the cracked concrete and buckled pipe along with wet areas around the outlet for any abrupt changes. |
| DISCHARGE CHANNEL     | The discharge channel is shallow and narrow with no riprap protection. The channel meanders downstream furnishing water to livestock.  | None   |
| EMERGENCY GATE        | A locked wheel on the emergency gate stem appeared secure. The depth of water at the stem was 12.5 feet. The gate services an 18-inch CMP before it enters the principal spillway outlet.  | None   |

# EMERGENCY SPILLWAY

| VISUAL EXAMINATION OF             | OBSERVATIONS   | REMARKS OR RECOMMENDATIONS |
|-----------------------------------|--|----------------------------|
| LEFT SPILLWAY<br>CONTROL SECTION  | The control section is an open cut into natural ground. The spillway is approximately 25 feet wide. A good grass cover except some bare areas extend through the control section.  | None                       |
| APPROACH CHANNEL                  | The approach channel is grassed with no obstructions.  | None                       |
| DISCHARGE CHANNEL                 | The grassed discharge channel is diverted downstream by a small earth berm at the left end of the embankment.  | None                       |
| RIGHT SPILLWAY<br>CONTROL SECTION | The control section is an open cut into natural ground. The spillway is approximately 25 feet wide. A good grass cover except some bare areas extends through the control section. | None                       |
| APPROACH CHANNEL                  | The approach channel is grassed with a recreational boat at the waterline.   | None                       |
| DISCHARGE<br>CHANNEL              | The grassed discharge channel is diverted about 200 feet downstream by any earthen berm at the right end of embankment.  | None                       |

# INSTRUMENTATION

| VISUAL EXAMINATION OF | OBSERVATIONS                              | REMARKS OR RECOMMENDATION                      |
|-----------------------|---|--|
| MONUMENTATION/SURVEYS | There are no known monuments in the area. | None   |
| OBSERVATION WELLS     | There are no observation wells.           | None   |
| WEIRS                 | There are no weirs.                       | None   |
| PIEZOMETERS           | There are no piezometers.                 | None   |
| STAFFGAGES            | There are no staffgages.                  | A staffgage should be placed in the reservoir. |

# RESERVOIR

| VISUAL EXAMINATION | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|--------------------|---|----------------------------|
| SLOPES             | The reservoir slopes are mild with little erosion. About 90 percent of the immediate area is pasture land with the remainder heavily wooded. There are no signs of slope failure. | None                       |
| SEDIMENTATION      | The inspection team was unable to evaluate the sediment in the reservoir.   | None                       |
|                    |   | None                       |

# DOWNSTREAM CHANNEL

| VISUAL EXAMINATION OF                                  | OBSERVATIONS  | REMARKS OR RECOMMENDATIONS |
|--|---|----------------------------|
| <p>CONDITION<br/>(OBSTRUCTIONS,<br/>DEBRIS, ETC.)</p>  | <p>The downstream channel is shallow and narrow. The flood plain is wide with little debris. The area is agricultural with thick grass over most of the area.</p> | <p>None.</p>               |
| <p>SLOPES</p>  | <p>The slopes are mild with good grass cover.</p>   | <p>None</p>                |
| <p>APPROXIMATE NO.<br/>OF HOMES AND<br/>POPULATION</p> | <p>Several farm structures are located within one mile below the Thornhill Dam. Some of these structures may be damaged if the dam were to fail.</p>              | <p>None</p>                |



APPENDIX IV

REFERENCES

## APPENDIX IV

### REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D. C.
2. HEC-1DB Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army Corps of Engineers, September 1978.)
3. "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian," Hydrometeorological Report No. 51, (U. S. Weather Bureau, June 1978).
4. "Rainfall Frequency Atlas of the United States", Technical Paper No. 40, (U.S. Weather Bureau, May 1961).
5. Bureau of Reclamation, U. S. Department of the Interior, Design of Small Dams, A Water Resources Technical Publication, Revised Reprint, 1977.

**DAT  
FILM**